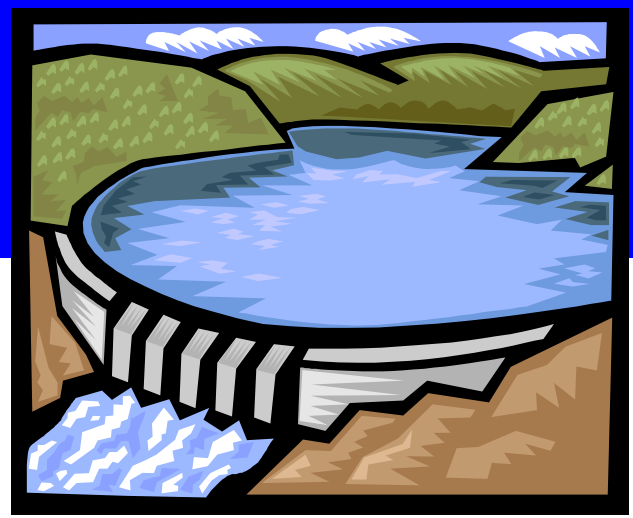
Forecast-Based Operations Of The Yuba And Feather River System



What is it?

Why do it?

How can it be done?

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BACKGROUND

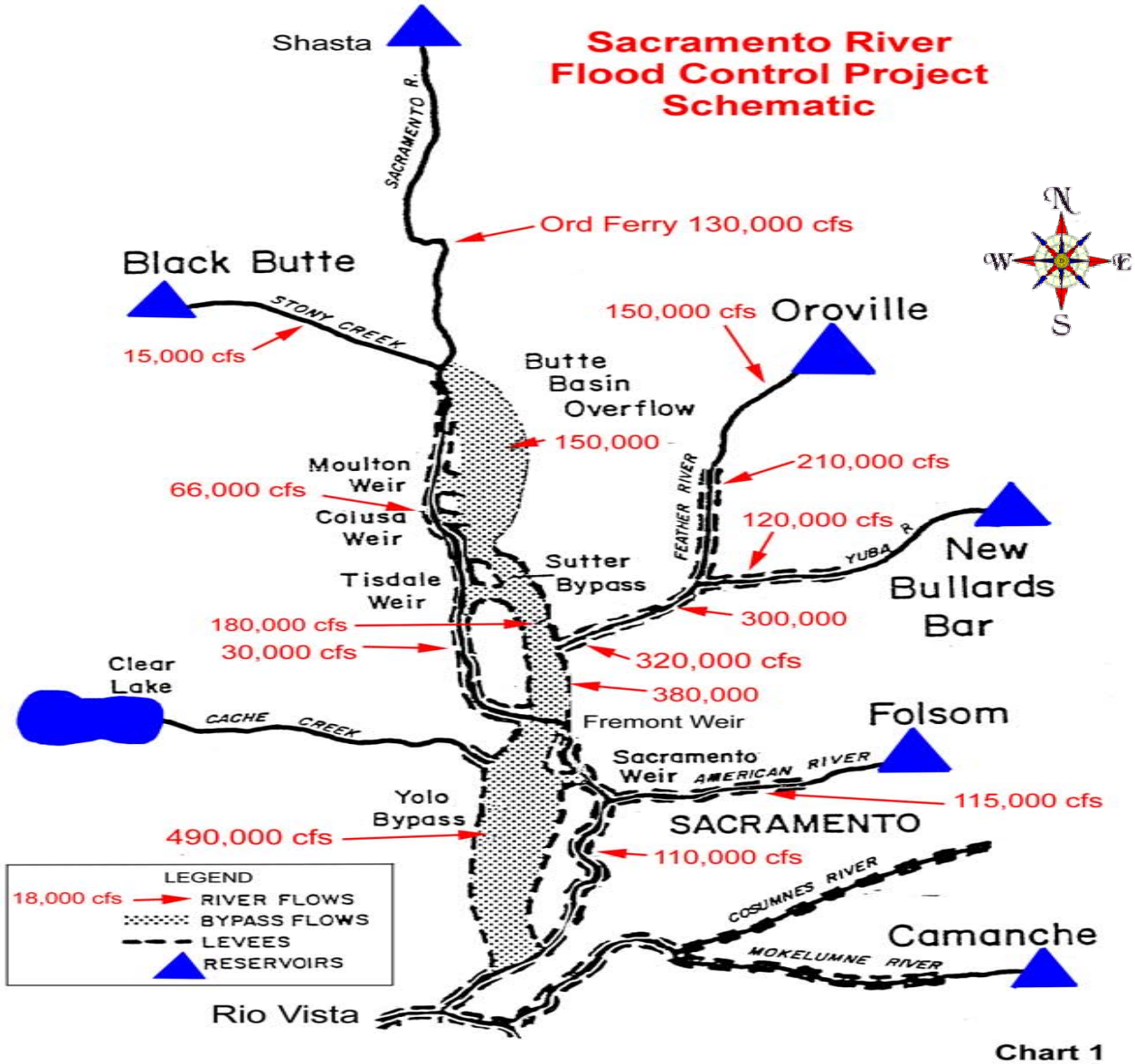
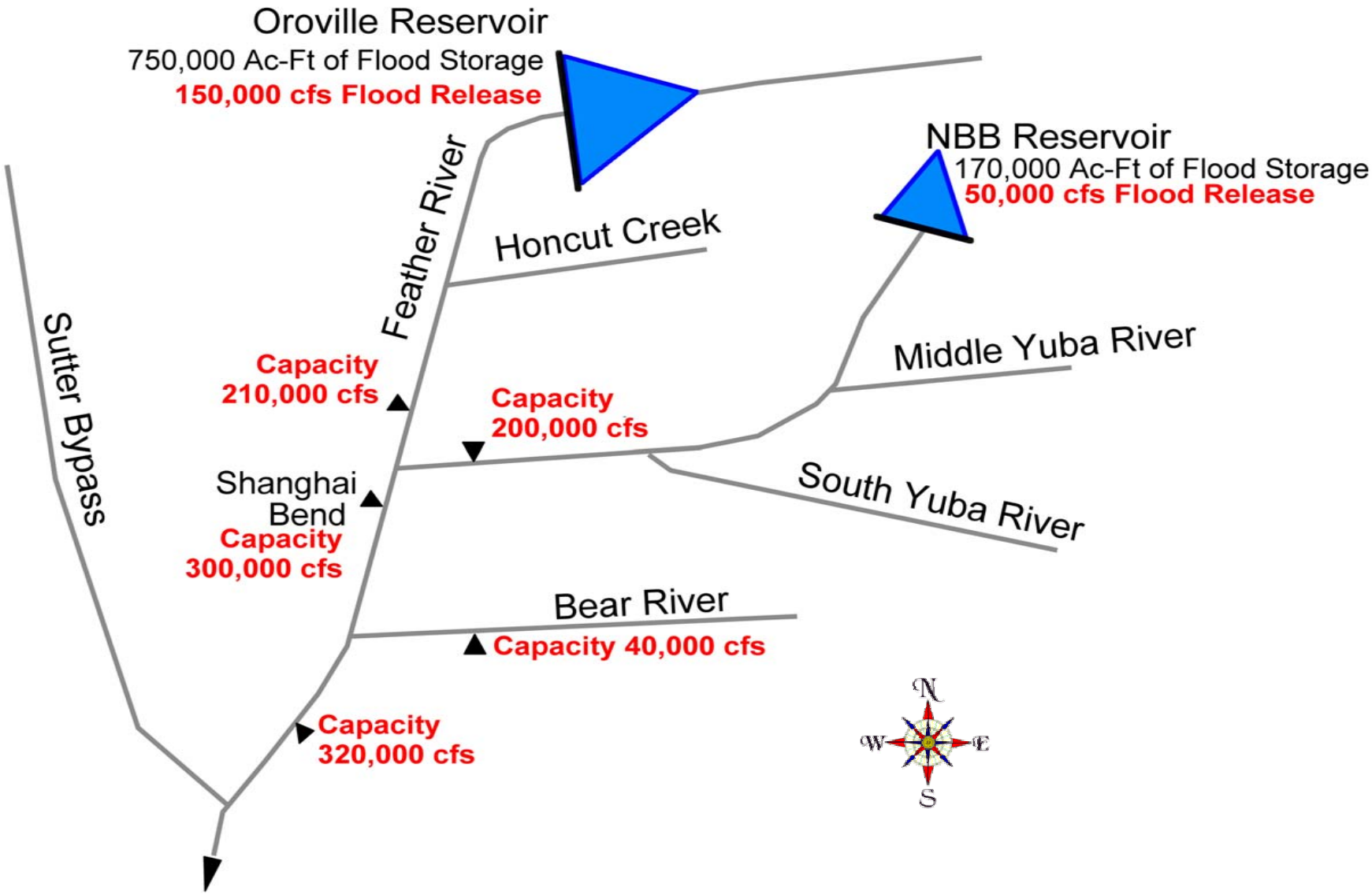


Chart 1

BACKGROUND


Oroville Reservoir
750,000 Ac-Ft of Flood Storage
150,000 cfs Flood Release
NBB Reservoir
170,000 Ac-Ft of Flood Storage
50,000 cfs Flood Release
Feather River
Honcut Creek
Middle Yuba River
South Yuba River
Sutter Bypass
Capacity
210,000 cfs
Capacity
200,000 cfs
Shanghai
Bend
Capacity
300,000 cfs
Bear River
Capacity 40,000 cfs
Capacity
320,000 cfs
N
W
E
S

WHAT IS IT?

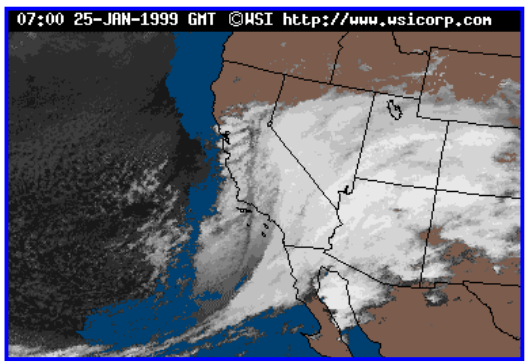
Why do it?

How can it be done?

FORECAST BASED OPERATION

Don't we do this already? NO!

Flood operation during which release decisions (operation) are made based on flow (reservoir inflow, tributary flow) forecasts.



Forecast

Operation

Operational Comparison

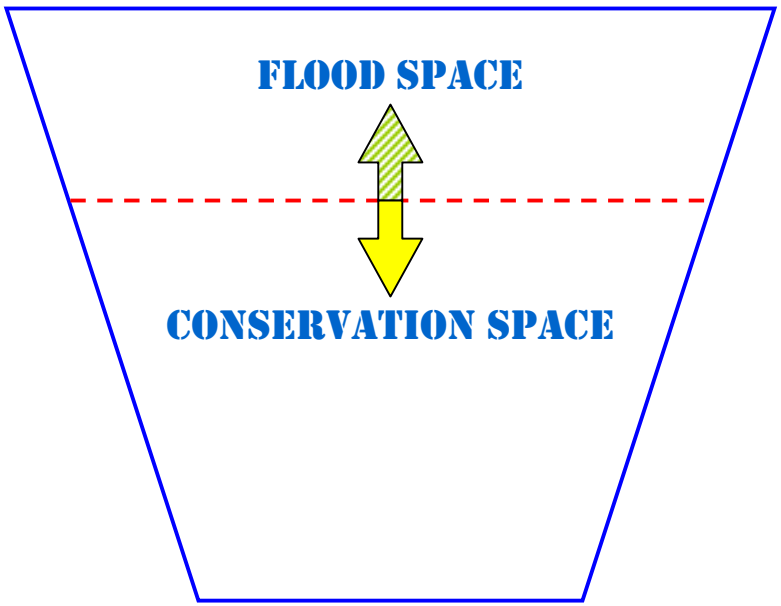
Comparison of current flood operation and FBO

	WY 2004 Operation	Forecast-Based Operation
Basis for Release	*Measured Inflow*	*Inflow Forecast*
Drawdown Limit	*Bottom of Flood Pool*	*?*
Encroachment	*No**	*?*

Otherwise… operations are the same

CONCEPTUAL GENESIS

- Flood/Conservation interface for most CA reservoirs depends only on seasonality and recent past hydrology
- Allow interface to fluctuate depending on forecast



ENHANCED

Water Supply

Flood Control

Flood vs. Water Supply Operations

Similarities

- Reservoir inflow forecast is made
- Forecast uncertainty must be understood
- Decisions are made based on forecast

Differences

- Runoff mechanism
- Magnitude of uncertainty
- Decision making time scale

What is it?

WHY DO IT?

How can it be done?

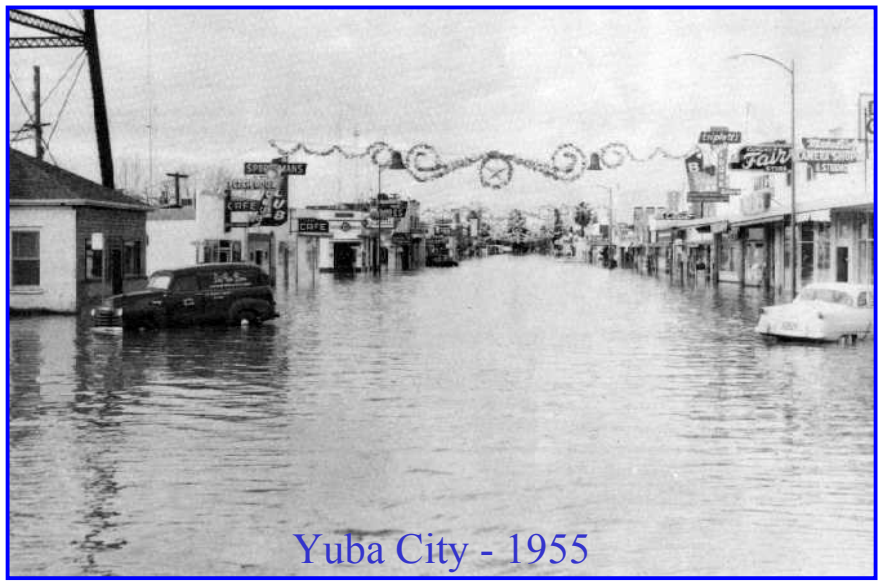
Historical Flood Damages

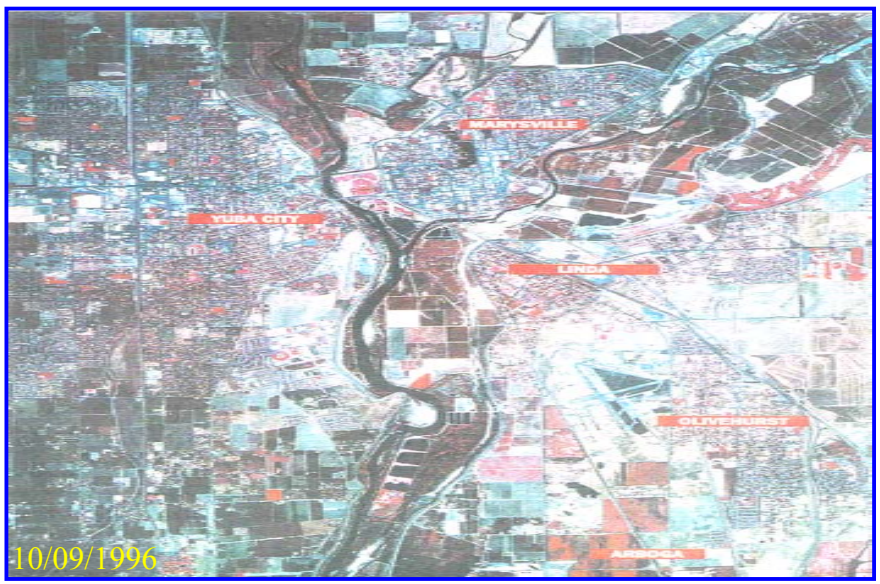
- February 1986 Flood
  - 10,700 acres inundated
  - 4,195 homes & businesses flooded
  - $95 million in damages
  - 1 life lost

- January 1997 Flood
  - 3 lives lost
  - 100,000 people evacuated
  - 16,000 acres inundated
  - 850 homes and businesses damaged or destroyed

BENEFICIARIES


Marysville - 1955

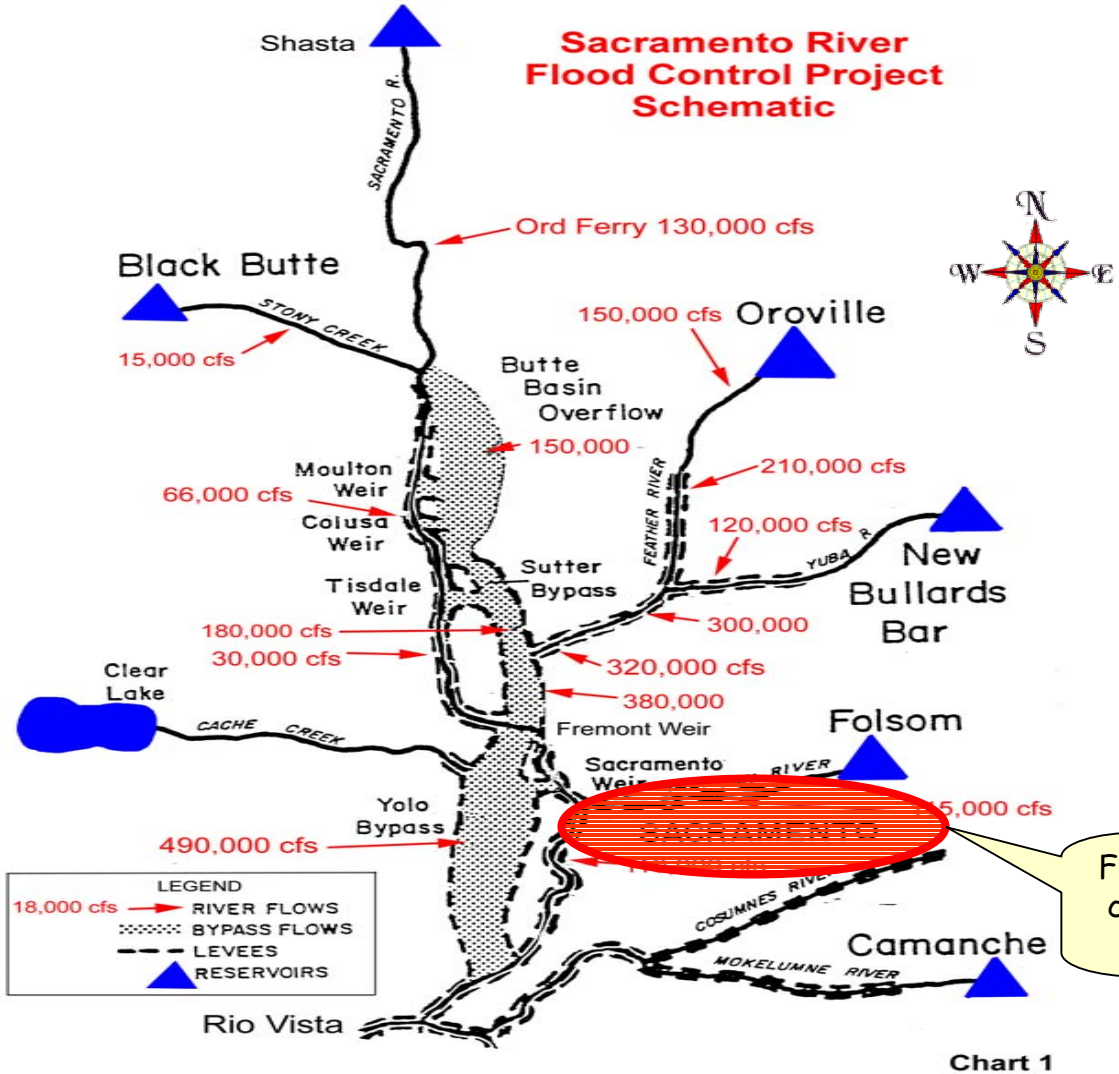

Yuba City - 1955



10/09/1996

01/03/1997

BENEFICIARIES



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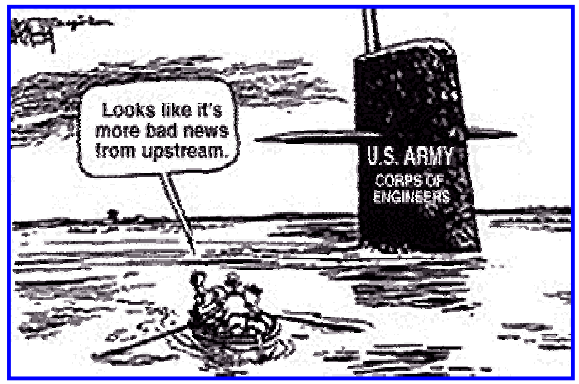


Feather River basin in key contributing area to flow at Sacramento

What is it?

Why do it?

HOW CAN IT BE DONE?

STRIKING A BALANCE

- FBO was designed for flood protection enhancement, but it is fully realized that it cannot exist as a “one-way street”
- Water supply and flood control operate counter to one another
- One’s benefit is a detriment to the other

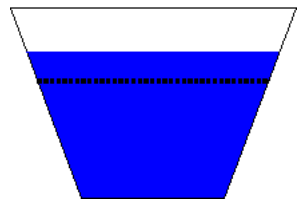
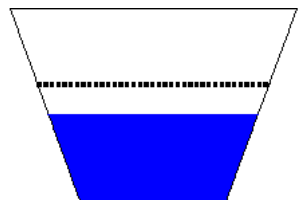
FBO Concepts

Forecast-based operation would likely consist of two phases

	Advance Release	Regulated Encroachment
Definition	Release water from conservation space when large inflow is forecast	Allow encroachment of flood space when small inflow is forecast
Trigger	Extremely Large Inflow Forecast	Small Inflow Forecast
Beneficiary	Flood Control	Water Supply
Expected Frequency	Once in Multiple Years	Several Times Annually

USE OF FORECASTS

How could forecasts be used to operate?

WEATHER FORECAST	OPERATION
MON TUE WED THU FRI 	 Regulated Encroachment
MON TUE WED THU FRI 	 Advance Release

FORECAST VS. ACTUAL

Not quite that simple… consider listing of potential forecast/outcome combinations

ACTUAL RESERVOIR INFLOW \ PREDICTED RESERVOIR INFLOW	Small	Large
Small	Operation as usual (FBO not activated)	FBO release too large *Potential water supply loss*
Large	FBO release too small *No worse than without FBO*	FBO release of proper magnitude

This risk is inherent but may be outweighed by benefits of regulated encroachment.

Influencing Factors

What factors influence effectiveness of FBO?

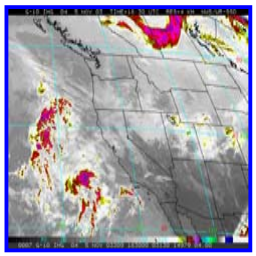
- Forecast lead-time
- Forecast error
- Available storage space
- Reservoir release capacity
- Downstream flows/targets
- Release rate of change

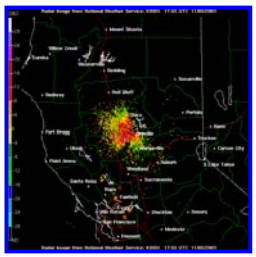
FLOOD FORECASTING SUMMARY

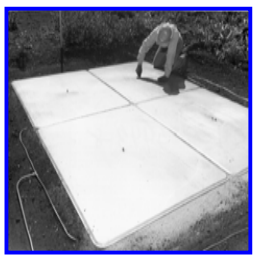
OBSERVE

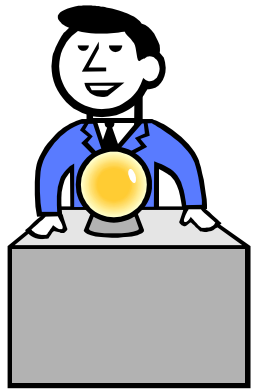
ANALYZE

PREDICT



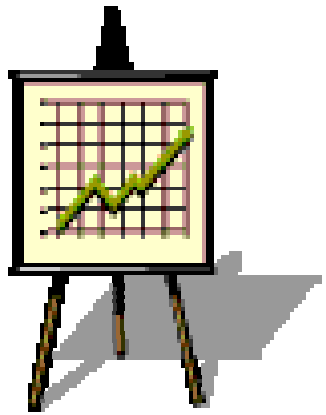






FORECASTER

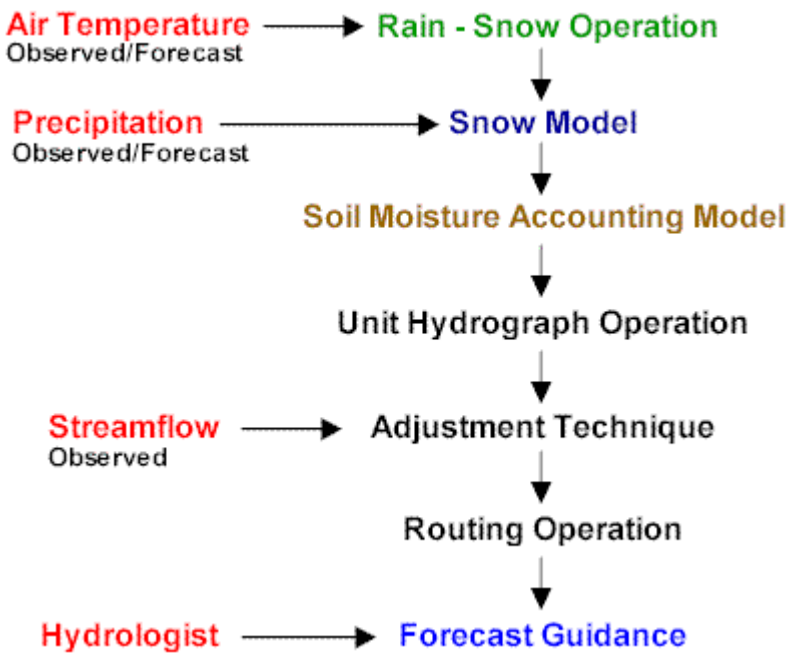
MODEL



FORECAST

Flood Forecasting Summary

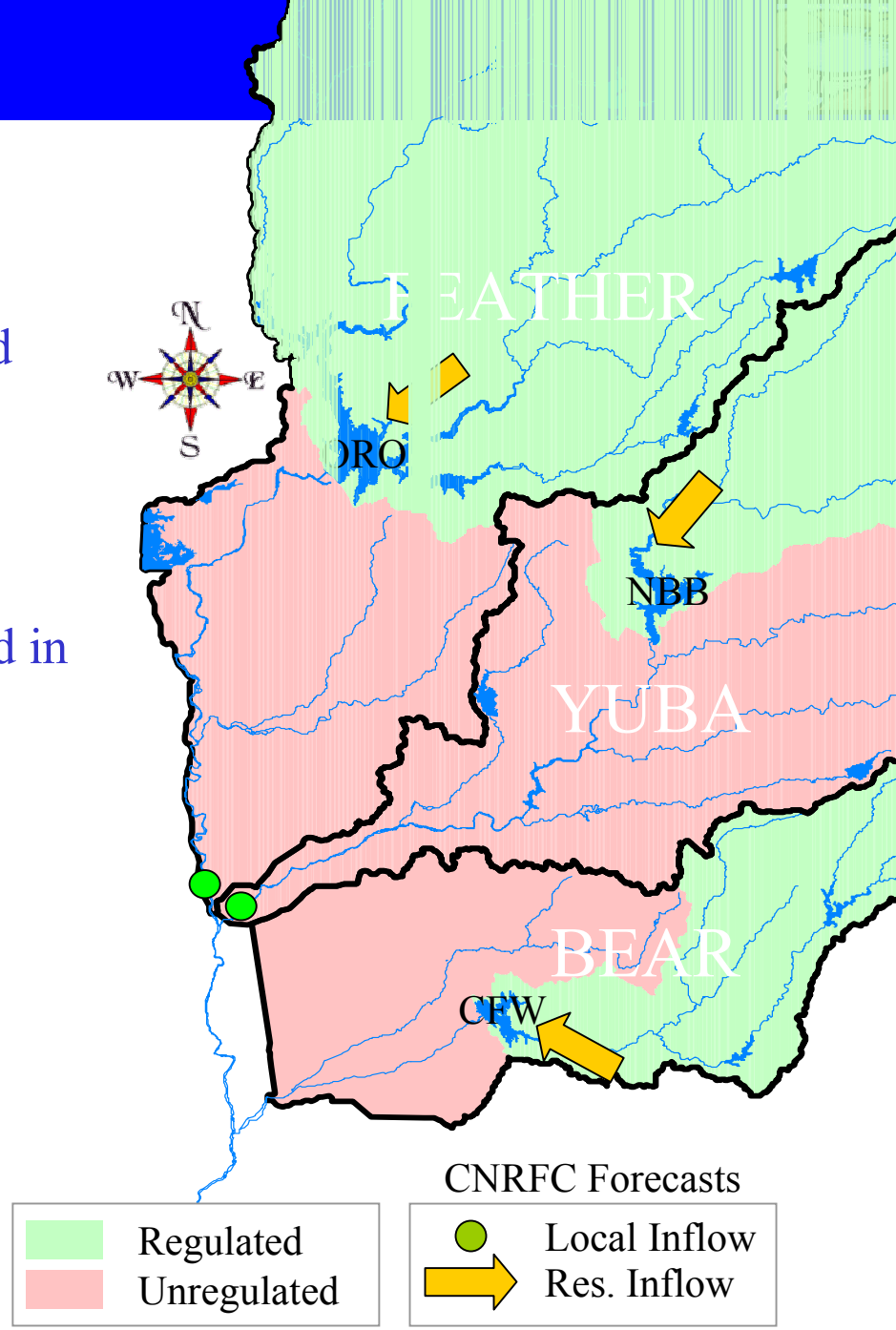
- Meteorologists predict precipitation and snow level
- California-Nevada River Forecast Center (CNRFC) uses this information to predict river stages downstream



Operational Forecasting

- CNRFC already provides the forecasts needed to perform FBO in the Yuba and Feather system

- Forecast uncertainty must be understood in order to select operational criteria



OPERATIONAL CRITERIA TO CONSIDER

How much encroachment should we allow?

REGULATED ENCROACHMENT

Under what circumstances should encroachment be disallowed?

How many days ahead should we look?

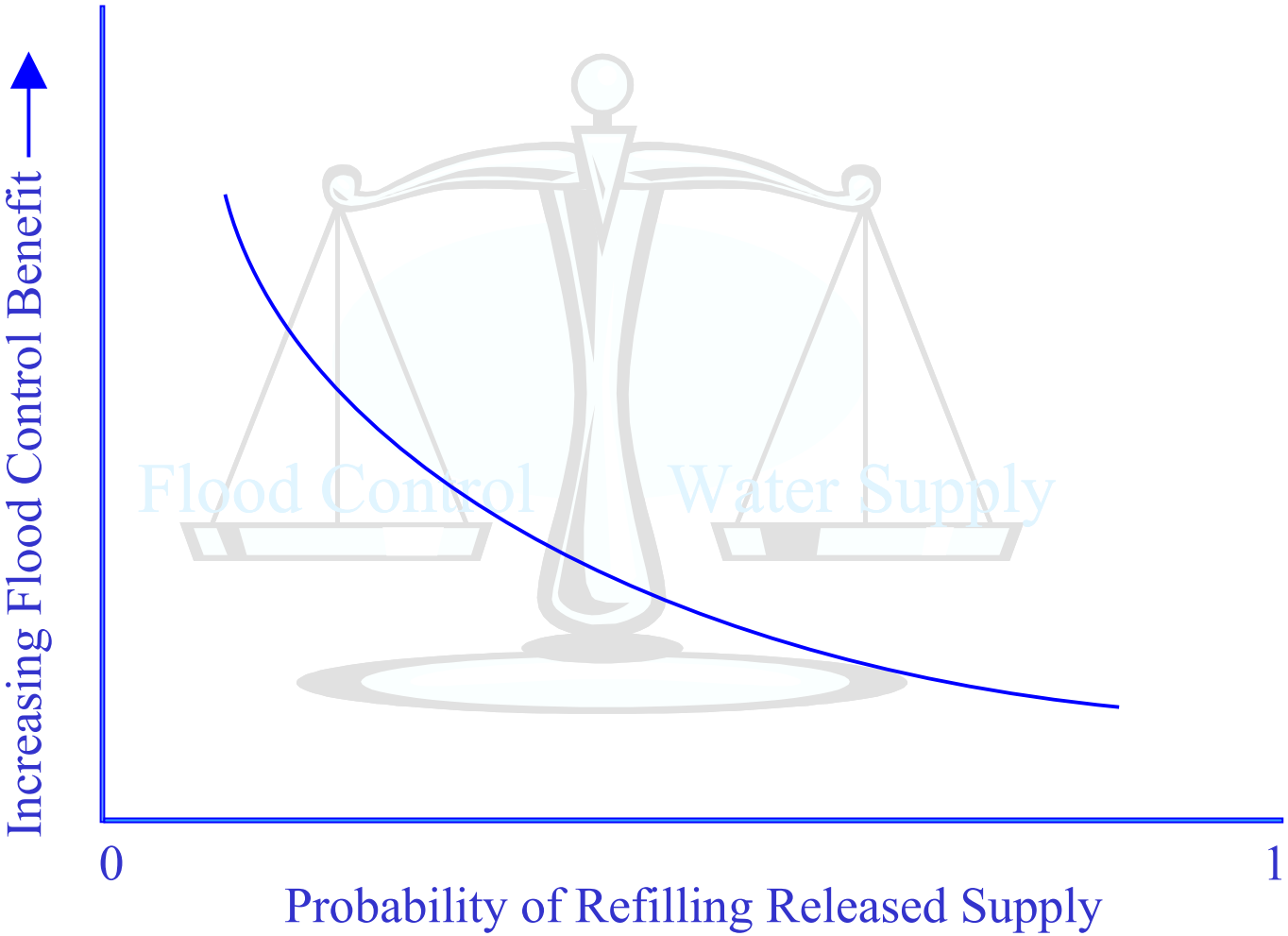
ADVANCE RELEASE

What magnitude forecast should initiate FBO?

Does volume released need to be limited?

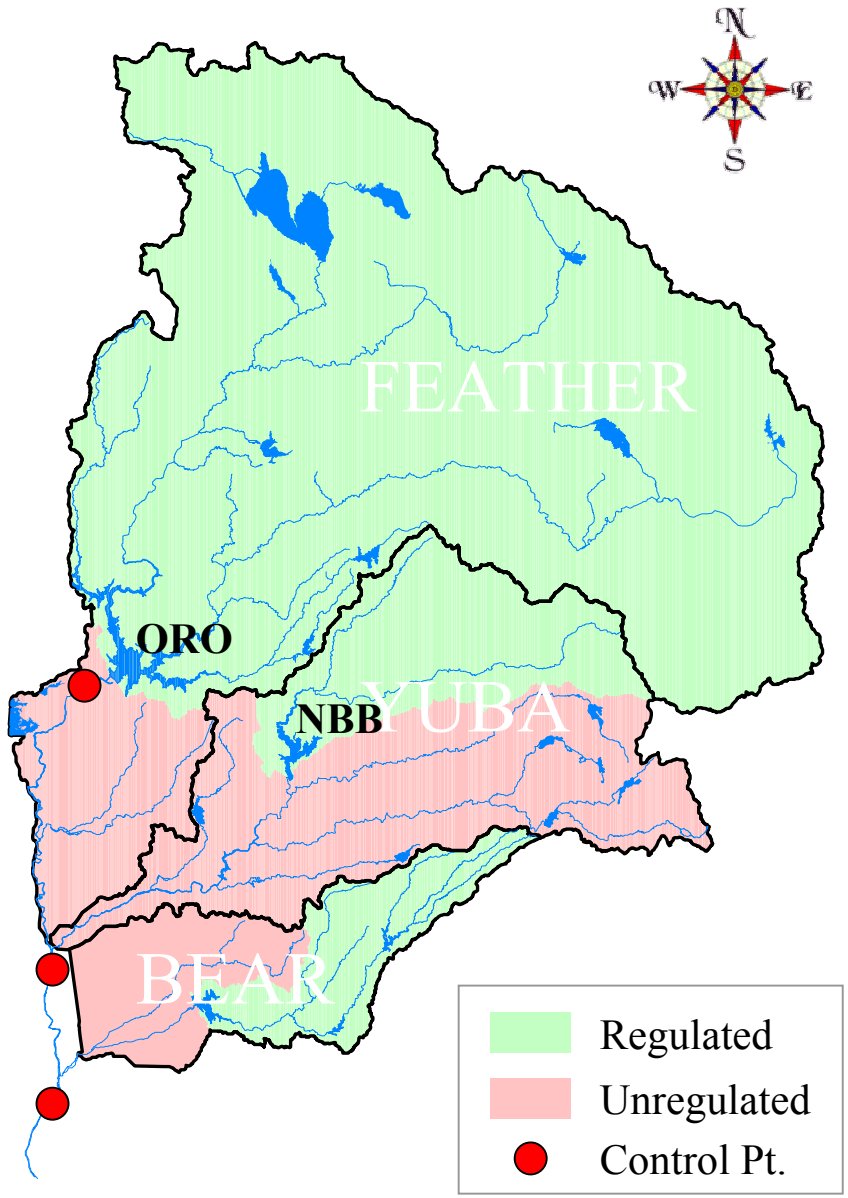
Operational Parameter Selection

Once forecast uncertainty is understood, operational criteria can be selected in terms of …

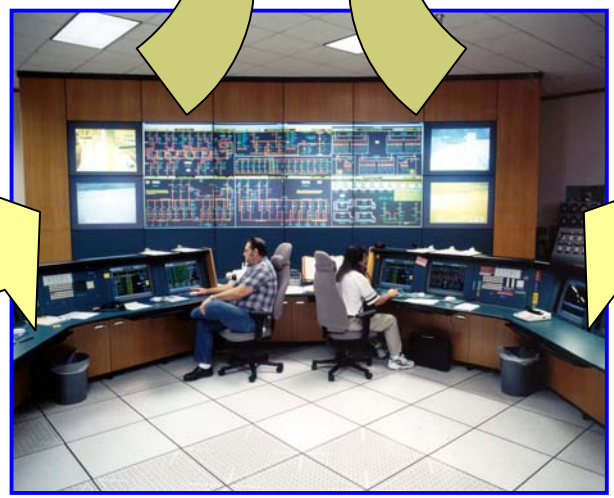


Operational Challenges

- Multiple reservoirs
- Large unregulated area
- Multiple downstream control points
- Ambiguous flood rules



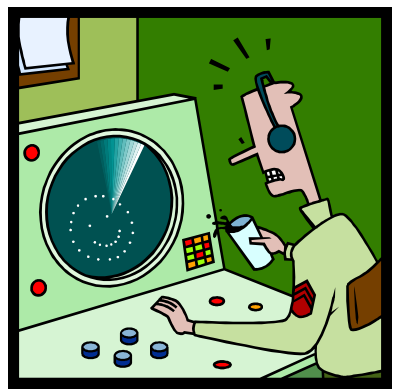
COORDINATED OPERATION



KNOWLEDGE TRANSFER

- Knowledge of FBO must be taken from idealized modeling to real-time implementation
- Operators must have tools and practice using them

MODELING

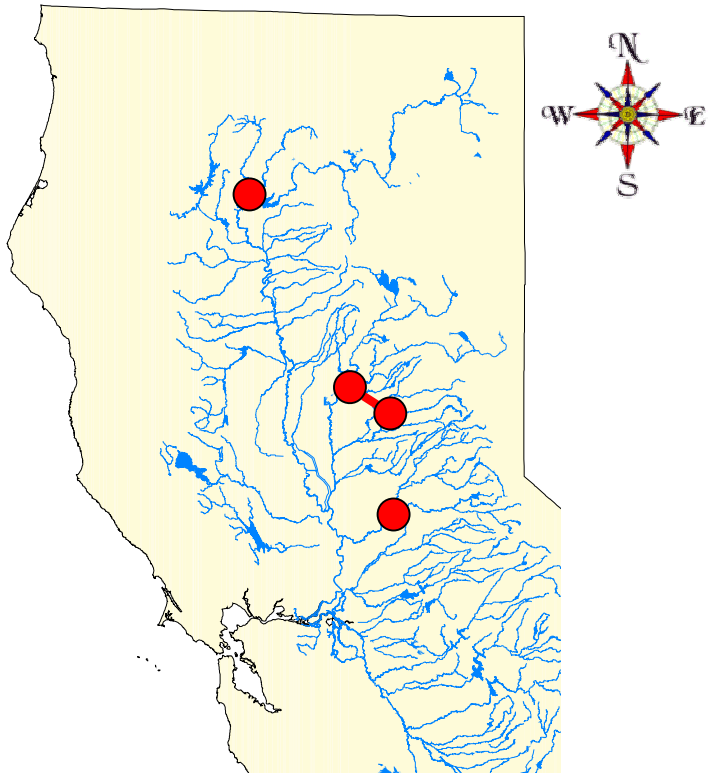


OPERATIONS

APPLICATIONS

FBO STUDIES

- Folsom
- Yuba/Feather
- Shasta



FBO IMPLEMENTATION

- None
  - Relatively new idea
  - Criteria selection needs study
  - Needs comprehensive understanding of impacts
  - Need stakeholder involvement

MERITS

FBO is considered to be a key methodology to enhance California's level of flood protection in the future… why?

- Forecasting advances have made it possible
- Significant addition of new physical flood control space is unlikely in near future
- Can be done with existing facilities – It's "free"
- Can be implemented so that it doesn't hurt water supply
- Can be done without significant modification of existing flood rules

CLOSING